DEPARTMENT OF THE AIR FORCE
DETACHMENT 3, AIR FORCE INSTITUTE FOR ENVIRONMENT,
SAFETY, AND OCCUPATIONAL HEALTH RISK ANALYSIS (AFMC)
APO AP 96368-5213

30 Nov 01

MEMORANDUM FOR 36 MDOS/SGOAB
Unit 14010, Box 19
APO AP 96543-5000

FROM: Det 3, AFIERA/CDR
Unit 5213
APO AP 96368-5213

SUBJECT: Consultative Letter (CL) IERA-DO-BR-CL-2001-0038, Radiation Protection Program Assistance Visit, Andersen AFB, Guam

1. This consultative letter (CL) documents my Radiation Program Assistance Visit to your office from 5-14 Sep 01. Specifically, this CL documents the following surveys:

a. Radiation scatter survey of Andersen AFB Air Mobility Command Passenger Terminal baggage x-ray system;

b. Radiation scatter survey of 36 CES/CED's XR-200 portable x-ray system; and

c. Radio frequency radiation (RFR) hazard assessment for 36 MXS/LGMWWC conventional air launched cruise missile (CALCM) maintenance operations.

2. Applicable Standards:

a. Air Force Instruction (AFI) 48-148, *Ionizing Radiation Protection*, 12 Oct 01.

b. Air Force Occupational Safety and Health Standard (AFOSH STD) 48-9, *Radio Frequency Radiation Protection Program*, 1 Aug 97.

3. Background and Survey Considerations:

a. Ionizing Radiation Scatter Surveys

(1) AFI 48-148 requires that the installation radiation safety officer control general public exposures to ionizing radiation from USAF practices, ensuring dose in unrestricted areas does not exceed 2 mrem in any one hour or 100 mrem in a year. Additionally, AFI 48-148 specifies that the dose to occupationally exposed workers not exceed 5000 mrem in a year.

(2) Andersen AFB's AMC Terminal operates a baggage x-ray inspection system requiring evaluation for compliance with public dose limits.

(3) Andersen AFB Explosive Ordnance Disposal flight, 36 CES/CED, operates a portable x-ray imaging device, the Golden Engineering XR-200, also requiring evaluation for compliance with public dose limits.

(4) For both x-ray systems, radiation exposure measurements were taken at the closest normally occupied locations to the source. A conservative exposure-to-dose conversion factor of 1.47 was used[1]. Dose calculations also assumed the most conservative occupancy factor of 1, corresponding to 2000 hours of exposure per year.

b. RFR Survey

(1) AFOSH STD 48-9 requires that the base Bioenvironmental Engineering Flight (BEF) evaluate all emitters capable of producing RFR levels exceeding permissible exposure limits (PELs) for periods of time that could result in overexposures.

(2) 36 MXS/LGMWWC, Verification and Checkout Equipment (VACE) section, performs maintenance on the AGM-86C CALCM, including periodic evaluation of the missiles' radar altimeters. The following three radar altimeter maintenance tests could produce hazardous RFR environments and require evaluation.

(a) In-place testing of the CALCM radar altimeter antenna.

(b) Guidance system tests using the missile radar altimeter test assembly (MRATA).

(c) MRATA calibration.

(3) For each maintenance process generating RFR, typical operating parameters were used to calculate expected RFR levels. These calculated RFR levels were then compared to AF exposure standards to recommend survey and control measures.

4. Results: Attachment 1 contains the survey results for the AMC terminal scatter survey. Attachment 2 contains the survey results for the EOD portable x-ray system scatter survey results. Attachment 3 contains the results of the RFR emitter evaluation for 36 MXS/LGMWWC CALCM radar altimeter maintenance.

5. Conclusions and Recommendations:

a. AMC Terminal Baggage Inspection X-ray:

(1) X-ray radiation levels in areas immediately adjacent to the baggage inspection x-ray machine during constant operation do not exceed any occupational or general public dose limits.

(2) 36 MDOS/SGOAB should routinely survey the AMC passenger terminal annually due to the unrestricted access (with regards to radiation exposure) by numerous non-occupationally exposed workers and members of the general public.

(3) Maintain a copy of this survey for a minimum of 3 years from the date of the survey.

b. 36 CES/CED XR-200 Portable X-ray System:

(1) X-ray radiation levels at the boundary of the 15-ft exclusion zone (per operating instructions) surrounding the XR-200 do not exceed any occupational or general public dose limits.

(2) 36 MDOS/SGOAB should resurvey the XR-200 following any refurbishment, replacement, or modification of the x-ray source (tubehead). 36 CES/CED should notify 36 MDOS/SGOAB when such a resurvey is needed. Routine survey of this system is not required.

(3) 36 MDOS/SGOAB should ensure that operators of the XR-200 receive initial and annual radiation safety training (i.e. ALARA or As Low As Reasonably Achievable training).

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[1]B. Schlein, L. Slaback and B. Birky, *Handbook of Health Physics and Radiological Health*, 3rd Ed., Williams & Wilkins: Baltimore, MD, 1998. The exposure-to-dose conversion factor is a function of x-ray energy. The most conservative value of all energies was used for this survey's calculation.

(4) Maintain a copy of this survey for a minimum of 3 years from the date of the survey.

c. 36 MXS/LGMWWC CALCM Radar Altimeter Maintenance:

(1) RFR emissions from missile radar altimeter antenna testing are controlled by use of RFR absorption hoods.

(2) RFR generating signals are considered dummyloaded (terminated within equipment electronics, as opposed to emitted from an antenna) for the processes using the MRATA.

(3) Calculations indicate that all processes investigated could produce ground level RFR emissions exceeding the PELs if either the absorption hoods leak from damage or improper installation, or if any of the waveguides (cabling) leak.

(4) 36 MDOS/SGOAB should annually survey the CALCM maintenance procedures to ensure that absorption hoods and waveguides do not leak. Additionally, 36 MDOS/SGOAB should verify that 36 MXS/LGMWWC conducts initial and annual RFR safety and awareness training for personnel performing CALCM radar altimeter maintenance.

(5) RFR measurements were not accomplished during this evaluation. 36 MDOS/SGOAB should coordinate with 36 MXS/LGMWWC to conduct initial RFR survey measurements.

6. If you have any questions regarding this letter, please call me at 634-2636, or e-mail me at kevin.martilla@kadena.af.mil.

Kevin E. Martilla

KEVIN E. MARTILLA, Maj, USAF, BSC
Chief, Radiation Services

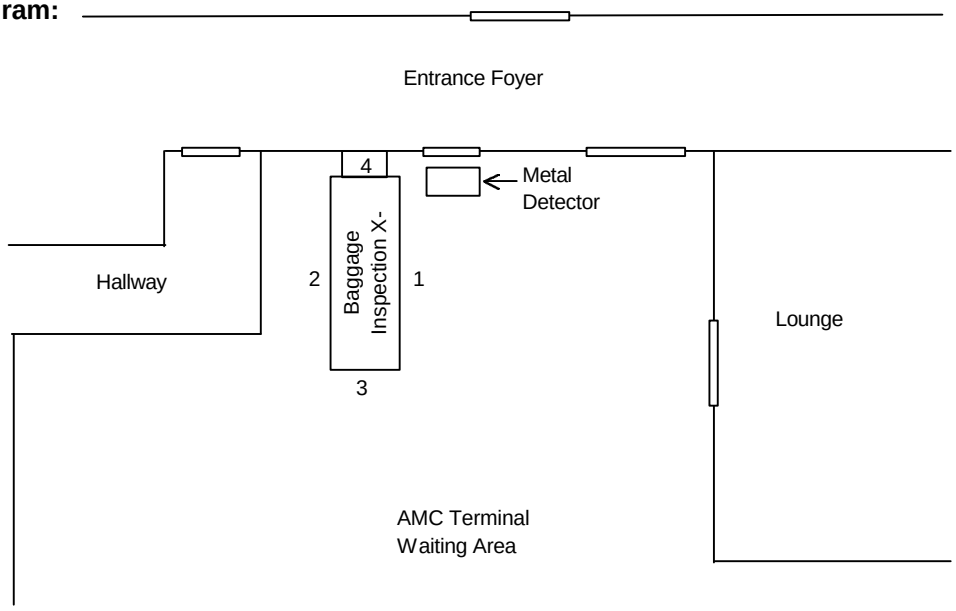
3 Atch
1. AMC Terminal Scatter Survey Form
2. EOD X-ray Scatter Survey Form
3. CALCM RFR Emitter Evaluation, AF Form 2759

X-ray Radiation Scatter Survey

Date:	Survey Instrument:	Serial Number:	Last Cal Date:
13 Sep 01	Ludlum 12S	102964	18 Jul 01

	Location	Exposure Rate-Gross (mR/hr)	Exposure Rate-Net (mR/hr)	Occupancy (T)	Restrict/ Unrestrict	Limit (mrem/yr)	Annual Dose (mrem/yr)	P/F
Background		0.001	--	--	--	--	--	--
1	Passenger Screening Area	0.01	0.009	1	Unrestrict	100	26	P
2	Operator's Location	0.021	0.02	1	Unrestrict	100	57	P
3	Baggage Exit Port	0.021	0.02	1	Unrestrict	100	57	P
4	Baggage Input Port	0.031	0.03	1	Unrestrict	100	86	P
5								
6								
7								
8								
9								
10								

Survey Diagram:



Notes:

- Based on exposure 2000 hr/yr.
- Dose calculation uses rem/roentgen conversion factor (CF) of 1.43 (Handbook of Health Physics and Radiological Health, Shleien, Slaback, and Birky, 1998). Value is most conservative monoenergetic conversion factor for energies ranging from 15 keV to 662 keV.

$$\dot{H}\,(mrem/yr) = \dot{X}\,(mR/hr) \cdot CF\,(mrem/mR) \cdot T \cdot 2000\,hr/yr$$

Performed By: KEVIN E. MARTILLA, Maj, USAF, BSC Det 3, AFIERA	**Radiation Protection Officer (Name, Rank):**
Permit #: N/A	**Radiation Protection Officer Signature:**

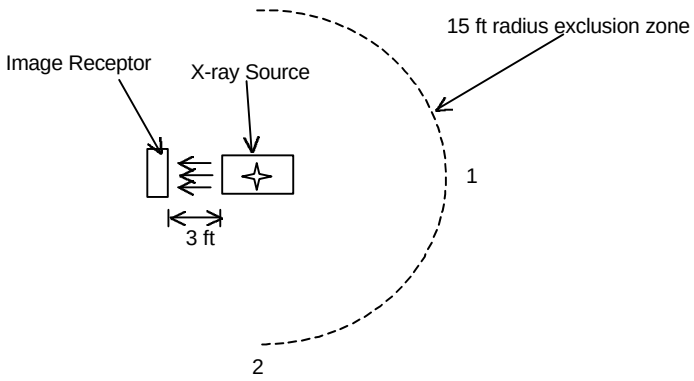
Det 3, AFIERA Form, Jul 01

X-ray Radiation Scatter Survey

Date:	Survey Instrument:	Serial Number:	Last Cal Date:
13 Sep 01	Ludlum 12S	102964	18 Jul 01

	Location	Exposure Rate-Gross (mR/hr)	Exposure Rate-Net (mR/hr)	Occupancy (T)	Restrict/ Unrestrict	Limit (mrem/yr)	Annual Dose (mrem/yr)	P/F
Background		0.001	--	--	--	--	--	--
1	Passenger Screening Area	0.002	0.001	1	Unrestrict	100	2.9	P
2	Operator's Location	0.008	0.007	1	Unrestrict	100	20	P
3								
4								
5								
6								
7								
8								
9								
10								

Survey Diagram:



X-ray source: Golden Engineering, XR200 X-ray Source

Notes:

- Based on exposure 2000 hr/yr.
- Dose calculation uses rem/roentgen conversion factor (CF) of 1.43 (Handbook of Health Physics and Radiological Health, Shleien, Slaback, and Birky, 1998). Value is most conservative monoenergetic conversion factor for energies ranging from 15 keV to 662 keV.

$$\dot{H}\,(mrem/yr) = \dot{X}\,(mR/hr) \cdot CF\,(mrem/mR) \cdot T \cdot 2000\,hr/yr$$

Performed By: KEVIN E. MARTILLA, Maj, USAF, BSC Det 3, AFIERA	**Radiation Protection Officer (Name, Rank):**
Permit #: N/A	**Radiation Protection Officer Signature:**

RADIOFREQUENCY EMITTER SURVEY	DATE (DD MMM YY) 10 Sep 01	WORKPLACE IDENTIFIER	
		BASE Andersen AFB	ORGANIZATION 36 MXS
		WORKPLACE Verification and Checkout Equipment	
		BLDG NO/LOCATION Bldg 5109	ROOM/AREA VACE

NAME OF CONTACT	GRADE	POSITION	ORGANIZATION/OFFICE SYMBOL	DUTY PHONE
T. Slama	SSgt	NCOIC, VACE	36 MXS/LGMWWC	366-3029
A. Staniger	SSgt	Section Safety Monitor	36 MXS/LGMWWC	366-3029

HAZARD EVALUATION AND CONTROL DATA

NOMENCLATURE	CALCM Radar Altimeter	CALCM Radar Altimeter	Frequency Generator	
DESCRIPTION	Radar Altimeter Test with RFR Absorption Hood	Radar Altimeter Test to Missile Radar Altimeter Test Assembly (MRATA)	Frequency Generator Calibration of MRATA	
LOCATION OF EMITTERS	Bldg 5109	Bldg 5109	Bldg 5109	
QUANTITY	1 per cruise missile	1 per cruise missile	1	
FREQUENCY (MHZ)	5000	5000	5000	
PULSE WIDTH (microsec.)	0.5	CW	CW	
PULSE REPETITION FREQUENCY (pps)	2000	CW	CW	
PEAK POWER (KW)	0.01	0.02	0.4	
ANTENNA CODE	RR	DL	DL	
ANTENNA SIZE (ft.) (hor./ver.)	0.33 X 0.33 ft	DL	DL	
ANTENNA GAIN (dB)	10	NA	NA	
SCANNING CODE	F	F	F	
SCAN RATE (rpm)	NA	NA	NA	
PERMISSIBLE EXPOSURE LIMIT (mW/cm2)	Cont - 10 Uncont - 3.33	Cont - 10 Uncont - 3.33	Cont - 10 Uncont - 3.33	
ESTIMATED HAZARD DISTANCE (ft)	Cont - 0.03 Uncont - 0.05	Cont - 0.01 Uncont - 0.02	Cont - 0.01 Uncont - 0.02	
HAZARD CODE(S)	GH	DL	DL	
HAZARD CONTROL CODE(S)	SO, WS. OM	SO, Check Waveguides	SO, Check Waveguides	
HAZARD DISTANCE MEASUREMENTS (ft)				

PREPARED BY (Name, Grade,AFSC)	REVIEWED BY (Name, Grade, AFSC)
KEVIN E. MARTILLA, Maj, USAF, BSC	

PERIODIC CHECKS

CHECK FREQUENCY ☑ ANNUALLY ☐ QUARTERLY ☐ OTHER _____

DATE (DD MMM YY)	SIGNS CURRENT	PROCEDURES ADEQUATE	OTHER	CHECKED BY

SYSTEM DIAGRAM, CALCULATIONS, AND MEASUREMENTS

Boeing AGM-86C, Conventional Air Launched Cruise Missile

36 MXS/LGMWWC, Verification and Checkout Equipment Section, performs maintenance on the AGM-86C, including periodic checks on missiles' radar altimeters.

The RFR hazards associated with AGM-86C maintenance stem from the following processes:

1. In-place testing of CALCM radar altimeter antenna. RFR absorption hoods are placed over the missile's antenna.
2. Guidance system test using the missile radar altimeter test assembly (MRATA)
3. Calibration of the MRATA.

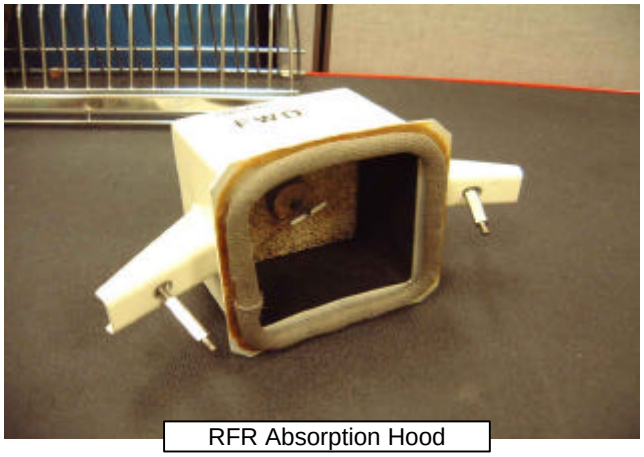
The first process poses a ground level hazard only if the RFR absorption hoods leak or are improperly installed. All processes pose a potential ground level hazard if the test assembly wave guides leak RFR.

The following control measures should be preformed during an annual workplace site visit:

1. Survey for leakage all absorption hoods and waveguides.
2. Review personnel training records to ensure RFR safety awareness training is accomplished.
3. Verify shop instructions and warning signs are current.

Shop personnel should contact Bioenvironmental Engineering regarding any new or changed process involving RFR.

AGM-86C with RFR Absorption Hood Attached



RFR Absorption Hood